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A CONIFEROUS SAND DUNE IN CAPE BRETON ISLAND

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(WITH EIGHT FIGURES)

Nova Scotia has been called "the long wharf of Canada." Cape Breton Island, which is cut off from the mainland by the Gut of Canso, may be likened to its outermost pier. The island (fig. 1), which is about 100 miles long by 30 miles wide in its northern portion, extends in a northeasterly-southwesterly direction, restraining the waters of the Gulf of St. Lawrence on the west and separating them from the Atlantic Ocean on the east. The latitude of 47° north cuts the northern end of the island a few miles to the north of Aspy Bay, on whose shores the coniferous sand dune is located. Nova Scotia lies in the coniferous belt, which occupies the upland with the mixed hardwood formation occupying the most favorable situations along the narrow coastal strip. The interior is occupied by a vast expanse of wet and dry tundra-like formations, bordered by gnarled and twisted dwarf spruce, the entire vegetational aspect being decidedly coastal rather than alpine.¹

The country is extremely rugged and the coastline jagged. Along the east coast is a narrow strip of sloping land, rarely a mile wide and often entirely lacking, which soon rises abruptly into an upland about 1000 ft. above sea level. In some places this upland plunges precipitously into the sea and the coast is very wild and bleak. This old Atlantic upland, which forms the backbone of the island, is the northern extension of the Piedmont Plateau. This upland has been cut during eons of erosion into deep gulches which extend far back into the central plateau. Down these gulches run swift and boulder-bedded streams to the sea. At the mouth of these streams intervalles are formed. Storm and tidal action have thrown shingle beaches and sand spits across the mouths of many of these reentrant bays (fig. 2). Upon one of these sand spits inclosing the South Pond of Aspy Bay is located the sand dune area which forms

¹NICHOLS, G. E., The vegetation of Cape Breton Island, Nova Scotia. Trans. Conn. Acad. Sci. 22:251-467. 1918.

the subject of this study. It is the only sand dune noted on the island. The area is located some 5 miles from the crest of the upland and is fully exposed on its western side to the terrific northwest

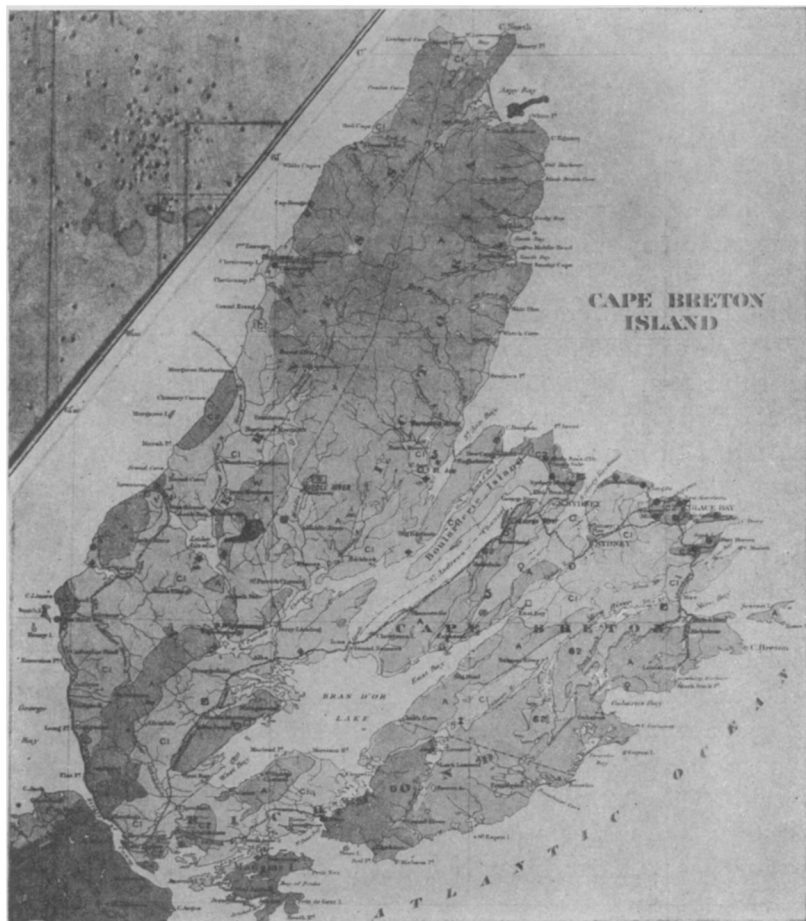


FIG. 1.—Cape Breton Island: Atlantic upland represented by dark shading; sloping marginal strip of lowland in light; Aspy Bay indicated by arrow.

winds, as well as to the cutting action of the outrunning tides from South Pond. The sand spit juts out to the southeast from a rocky upland reaching a total length of approximately $\frac{1}{2}$ mile, with a maximum width at the present time of less than 650 ft., and with a

minimum of less than 400 ft. But for the swift running tidal currents the spit would completely impound South Pond, extending across to the other headland; at best only a shallow and narrow channel now exists.



FIG. 2.—Aspy Bay region: sand spit on which sand dune is located marked by arrow; light shading indicates upland; dark shading indicates lowland.

The present condition of the area may be seen from fig. 3, which attempts to show the distribution of the existing plant associations. The dune complex, which is some 300 ft. wide, occupies less than one-half the length of the spit, being replaced in part at its southeastern extremity by a middle beach 400 ft. in width.

On the east the dune complex is fronted by a middle and lower beach, each with a width of approximately 100 ft. The lower

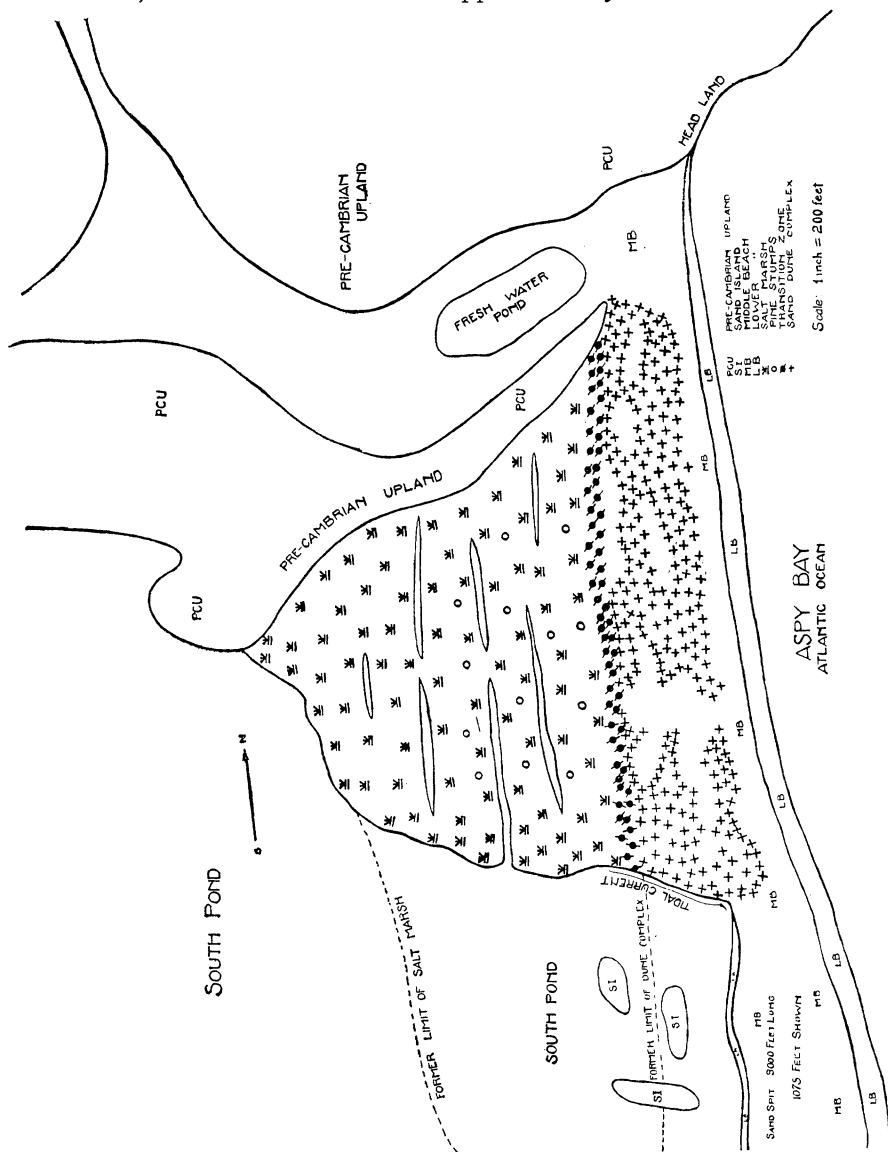


FIG. 3.—Diagram of present distribution of plant associations of dune complex

beach maintains its average width on the east side of the duneless end of the spit, where it has a gentle slope, but on its west side the

lower beach occupies a narrow steep margin only a few feet wide. To the immediate west of the spit in South Pond are several isolated sand islands (S.I.) mostly covered at high tide. To the west of the dune complex a transitional zone some 50 ft. wide separates it from an extensive salt marsh which is about a foot lower, and whose average width is estimated at 1200 ft. Several narrow salt water lagoons traverse this area in a north-south direction. Extending out into the marsh some 600 ft. along the eastern border is an area occupied by 10 or 15 old white pine stumps, approximately 100 years old, with well exposed roots, and standing in rows more or less parallel to the axis of the spit. The south end of the salt marsh and dune complex are suffering very active erosion under the daily outgoing tidal currents. High tides and occasional storms apparently sweep completely over the low duneless extremity of the spit, greatly augmenting this erosion. We may now consider each of these associations in greater detail.

Middle beach

The middle beach, which is extremely barren, is composed mostly of a fine sand, but shingle of a coarser nature is not wanting. The usual débris of the middle beach is encountered only to the east of the dune complex (fig. 4). The 3 principal plants are *Mertensia*² *maritima*, *Euphorbia polygonifolia*, and *Ammophila arenaria*, but all are exceedingly scattered. The only other species noted were *Glaux maritima*, *Lathyrus maritimus*, *Salsola Kali*, *Cakile edentula*, and these are represented only by occasional individuals.

Dune complex

The facies of the dune complex is *Picea canadensis* with occasional *Abies balsamea*. At the northern end the older trees were estimated at 75 years, while those at the southern, eroding end are scarcely 30-40 years of age. The southern (fig. 5) and eastern fringes of the complex include the highest dunes, which range from 3 to 15 ft. above sea level, and are generally margined by a narrow "grassy foredune" (fig. 6) with its precipitous slope oceanward. The sand binder is *Poa compressa*, a most unique condition. *Ammophila*, although scatteringly present, is of little importance in

² Nomenclature of GRAY's *New Manual*, 7th ed.



FIG. 4.—Southeast end of dune complex, from east, showing middle beach, the *Picea-Abies* stand, and grassy foredune; South Pond and highland beyond is shown at extreme left; photograph by Dr. G. E. NICHOLS.



FIG. 5.—Southern and eroding end of dune complex, from south: South Pond and highland to west seen at left; middle beach is well shown; evidence of recent and rapid erosion plainly evident.

this respect. Associated species are *Euphorbia polygonifolia*, *Taraxacum*, *Iris versicolor*, *Rhus Toxicodendron*, *Rubus* sp., and *Ribes oxycanthoides*, all of which occur sporadically.

On the thickly wooded lea slope of these grassy dunes are found numerous woody and herbaceous species. The most prominent



FIG. 6.—Grassy foredune held by *Poa compressa*, from north: middle beach and naked spit seen to south; highland shown to south of South Pond (barely visible); photograph by Dr. G. E. NICHOLS.

species are *Iris versicolor*, *Campanula rotundifolia*, *Vaccinium Vitis-Idea*, *V. pennsylvanicum*, *Maianthemum canadense*, *Rhus Toxicodendron*, *Ribes*, and *Rubus*. The occurrence of these forms is sporadic.

In some places this outer range of dunes passes toward the west into low areas of considerable extent occupied by a unique association (fig. 3, blank areas in dune complex). Its aspect is grassy,

determined mainly by *Festuca rubra*, *Danthonia spicata*, *Agrostis maritima*, and *Panicum implicatum* in rather open formation. *Lechea intermedia*, *Vaccinium Vitis-Idaea*, *Potentilla tridentata*, *Fragaria virginiana terra-novae*, *Juniperus horizontalis*, *Empetrum nigrum*, *Barbula*, and a species of moss form more or less extensive mats. Other more scattered species are *Campanula rotundifolia*, *Euphrasia americana* (?), *Cerastium arvense* (?), *Solidago bicolor*, *Plantago maritima*, *Iris setosa* (?), *Veronica serpyllifolia*, *Arenaria lateriflora*, *Plantago major*, and several ruderals.



FIG. 7.—*Picea canadensis* showing layering; individual trees plainly seen in center of fig. 5.

A second and in some places a third series of much lower dunes is met in transect to the west. At the northern end of the complex practically all the white spruce is excessively infected with *Arceuthobium pusillum*, presenting the most remarkable development of witches' brooms it has ever been my privilege to see.

We have here a most remarkable physiographic condition of a dune moving seaward. The trees have mostly germinated at a lower level, and as the sand blows over the rounded top of the "grassy foredune" it forms a gentle lee slope to the west among these trees. As the trees are covered, abundant layering takes place, giving a long-lived and self-perpetuating stand (fig. 7). There

is some evidence, however, that germination actually takes place on these grassy dunes. Through layering and germination the complex slowly moves oceanward.

Salt marsh

The aspect of the salt marsh is determined by *Spartina glabra*, *S. patens*, and *Distichlis spicata*. *Juncus balticus littoralis* is very abundant along the drier margins. Other common species are *Salicornia europaea*, *Potentilla pacifica*, *Ranunculus Cymbalaria*;



FIG. 8.—Salt marsh from eastern margin; *Pinus Strobus* stump in foreground; lagoons and South Pond in background; photograph by Dr. G. E. NICHOLS.

while *Vaucheria* and *Cladophora* occur in great mats on the margins of pools. The most striking feature, however, is the presence of numerous white pine stumps (fig. 8), remnants of a lumbering operation, whose distribution simulates rows parallel to the axis of the spit extending from the eastern shore out into the marsh to a distance of several hundred feet. The roots of these stumps are well exposed. It is evident that they must have germinated upon land possibly a foot or more higher than this, somewhat over a century ago. It is also evident that the salt marsh has encroached from the west and is moving eastward. Coastal elevation or denudation

could account for this encroachment, and I believe the latter more probable. The erosive force might well have been wind, acting subsequent to the removal of the white pine forest which evidently existed here. High tidal action has undoubtedly cooperated in the removal of the upper part of what appears to have been an extensive sand plain, as indicated by the north and south extensions of the lagoons.

Restoration of original condition

Within a century it seems probable that an area somewhat more extensive to the south than that now occupied by the salt marsh, and lying in the lee of the highlands to the north, was covered with a stand of *Pinus Strobus*. The present area of the dune complex, lacking this protection from marine influences, was covered with a stand of *Picea canadensis* and *Abies*, and this stand extended in its full width to the present end of the spit. It seems probable that the dune complex is a relatively recent phenomenon, developing subsequent to the removal of the stand of white pine. At about this same time the channel of the tidal current was changed and began cutting at the south end of the spit, eroding the *Picea* stand (fig. 5). According to a native, about one-third of this erosion has been accomplished in the last 35 years, or at the rate of 25 ft. per annum. If this rate has been approximately constant, the *Picea* stand was intact within a century to the end of the spit, which now lies bare for about one-half mile (fig. 3).

Summary

It is the purpose of this paper to put on record several facts of ecological interest: (1) a coniferous sand dune with *Picea canadensis* as its facies located at the latitude of 47° north; (2) *Poa compressa* as a sand binder; (3) abundant layering in *Picea canadensis* and *Abies balsamea*; (4) the anomalous condition of a sand dune moving seaward; (5) a phenomenal development of *Arceuthobium pusillum* on *Picea canadensis*; (6) the decisive value of ecological data in the interpretation of physiographic phenomena.